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THE UTILISATION OF TROPICAL HARDWOOD PLANTATION TIMBERS FOR PULP AND PAPER MAKING

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The Utilization of Tropical Hardwood Plantation Timbers for Pulp and Paper Making

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1. Introduction

(a) The demand for paper and paper products is increasing rapidly throughout the world, but this increase is especially marked in the new developing countries of Asia and Africa. The technical, cultural and educational developments taking place in these countries have already resulted in greatly enlarged imports of paper and, as development programmes are implemented, and education spreads, this trend is likely to accelerate greatly. In Nigeria, for example, during the six years immediately prior to the attainment of Independence in 1960, the annual expenditure on paper and paper products increased from about £1 million to nearly £3 millions.

(b) Most of the developing countries are traditionally primary agricultural producers, but with the social and political awakening of the last decades, the growth of industries is proceeding rapidly in many tropical countries. The manufacture of paper is an industry that often attracts considerable attention in development programmes: in view of the rapidly growing demand for paper products, the development of this industry appears desirable. It must be borne in mind, however, that special problems arise in connection with the establishment of pulp and paper industries in developing tropical countries; although these problems can be overcome by adequate planning and research, it is well not to underestimate them.

2. Problems of the Paper Industry in Developing Countries

(a) Perhaps the most important problem in the establishment of a paper industry in a new, relatively under-developed country is that of scale.

(i) Paper making is essentially a large scale operation, and cannot be conducted profitably at an output below a certain level. This minimum output has been variously estimated by

different experts, and, of course, varies with the economics of the individual country, and the type of raw material and process used, but it is unlikely that, in an underdeveloped country, with high overheads and supervisory costs, and where chemicals, etc. have to be imported, a production of lower than 20-30 tons/day would be commercially successful.

(ii) The total paper requirements of many of the smaller developing countries do not as yet approach this figure, and, in these cases, it would seem wise to defer any consideration of the establishment of a paper industry until such time as the demand may reach this level. In this respect, however, Nigeria is in an especially fortunate position to embark on the manufacture of paper. Extrapolation of available import figures suggests that the paper requirements of this country will pass 100 tons/day by 1965, a requirement which can fully absorb the production of a general purpose mill.

(b) Another major problem is that of technical expertise. The paper-making industry antedates the scientific revolution, and depends to a great extent on the traditional skills of the craftsman. It has been said that "it takes three generations to make a paper maker" and, although this may be an exaggerated view, there is no doubt that these traditional craft skills cannot be acquired overnight. The training of craftsman for the paper industry in the newer countries, where few traditions of such skills exist, is likely to be more difficult than staffing the industry at the management and engineering levels.

(c) The third important problem, consideration of which leads on to the main theme of this paper, lies in the unfamiliarity to the paper-maker of the locally available raw materials.

(i) The paper industry has developed mainly in Northern countries where the most readily available cellulose is that derived from the natural coniferous forests of the temperate and sub-arctic regions of the Northern Hemisphere. These softwoods are inherently suitable for the manufacture of paper pulp, on account of their comparatively long ultimate fibres, their relative ease of pulping, and many other characteristics. A great deal of information and experience has been built up around these materials, and they are by far the most familiar source of cellulose fibre to the paper-maker. The non-traditional raw materials available in tropical countries are comparatively little known, and difficulties in their use may be encountered.

(d) Many other problems also may arise, but are beyond the scope of this paper, which is mainly concerned with the provision of suitable cellulosic raw material.

3. Indigenous versus Imported Pulp

(a) Before proceeding to this main theme it may be appropriate to consider the policy of operating a paper mill

in an emergent country on the basis of imported pulp

(b) The policy may well be a wise one in the early stages of the development of the industry. Pulp could be imported from the established producer countries, at prices which are likely to compete favourably with those at which pulp can be manufactured locally. The new paper making industry can then have an opportunity to establish itself securely, using a familiar type of pulp, before the additional capital expenditure on a pulp mill is incurred, and while necessary research on the local raw materials is being undertaken.

(c) However, to plan a new paper industry to be operated indefinitely on the basis of imported pulp would probably not be ultimately in the best interests of the economy of the country.

(i) Cellulose is one of the most ubiquitous of natural products, and there is hardly a country in the world which does not produce sufficient to satisfy the local paper-making requirements. As most of the new developing countries are traditionally primary producers, it is desirable to link their newly expanding industries to local raw materials, thus giving encouragement to existing agricultural and forestry operations.

(ii) If the economics of the paper mill are considered in isolation, the continued use of imported pulp may appear favourable. This policy implies, however, that the paper industry is continuing to be dependent on the industrial and forestry operations of the established industrialized countries - which the industry of a developing country can ill afford to be.

(iii) Even if slightly lower profit margins in the paper mill itself result from the use of locally manufactured pulp, this will mean that the mill is subsidizing other operations, industrial, agricultural or forestry, within its own country.

(d) This problem must also be considered from the point of view of the availability, on the global scale, of pulpable raw materials. Although the softwood reserves of the northern forests are far from being exhausted, considerable depletion of available supplies has already taken place, and attention is being paid, even in the established producer countries, to the exploitation of less conventional materials. Against this background, the increased use of tropical cellulosic materials appears even more desirable.

(e) In summary, it is considered that wherever possible a paper industry in a developing country should be based on locally manufactured pulp, although the use of imported pulp may be expedient during the earliest years of the establishment of the industry.

4. Alternative Sources of Pulp

(a) Three main sources of pulping material must be considered in addition to hardwoods: these are; waste paper and rags; agricultural residues; and softwood timbers. These materials are all used for the manufacture of pulp, but the conditions prevailing in underdeveloped countries may seriously limit the choice of materials suitable for local utilization. The materials may be considered briefly:-

(b) Waste Paper and Rags

(i) In most highly industrialized countries, very considerable quantities of waste paper are collected, and repulped. At the present time, however, no organized collection of waste paper is made in most of the developing countries, and it is unlikely that quantities large enough to be worth the effort of collecting and sorting would be available at any one centre, except possibly in a few of the largest towns, for some years to come. Furthermore, stock prepared from waste paper pulp is in general only suitable for the manufacture of lower grades of cardboard, and similar materials.

(ii) In view of these considerations, it is suggested that, at the present time, waste paper is not likely to prove a useful raw material for the pulp/paper industry in developing countries. As paper consumption increases, however, this position may change, and it is well to keep the possibilities of this material under review.

(iii) Although the highest quality papers can be made from rags, the availability of this material in the less developed countries is entirely insufficient to warrant its serious consideration. Furthermore, the local demand for high quality rag papers is likely to be very small.

(c) Agricultural Residues.

(i) Although agricultural products, such as straw, are widely used for the manufacture of paper pulp in countries where agricultural operations are highly mechanized, it does not follow that similar raw materials are likely to be particularly promising in the less developed areas of the world.

(ii) Agriculture in these countries is based largely on the production of peasant farmers, cultivating individually small plots, so that the logistics of obtaining a sufficient quantity of bulky material in any one place becomes a major problem. Production in most cases is highly seasonal, and storage of such materials under tropical conditions for protracted periods may result in serious loss of quality. Further, such materials already serve a number of useful purposes in rural economies (thatching, manufacture of matting and cordage etc.) and the disruption of such trades and crafts is undesirable.

(iii) An exception to these generalizations, however, is bagasse, which material already finds extensive use in the paper industry in many countries, and whose use could doubtless be increased, where sugar cane is grown. Even in this case, however, there is the disadvantage of seasonal production.

(d) Softwood Timbers.

(i) Where softwoods are readily available as part of the natural forest of the country concerned, they will normally be a preferred raw material to the paper pulp manufacturer. Many coniferous species, for example the tropical pines such, as Pinus caribaea and P. taeda, are already extensively used as pulpwoods in tropical and sub-tropical countries.

(ii) In many of the emergent countries, especially in Africa, no natural coniferous forests exist. In some cases, exotic conifers have been introduced, and successfully established on a plantation scale (for example, Cupressus and Pinus spp. in Kenya). W here this has taken place, these materials can doubtless be of great value to a pulp industry.

(iii) From a long-term point of view, there is scope for extensive forestry research on the introduction of coniferous species in other tropical countries, but, where no such introductions have yet been made, it must/many years before they can be/ contribute anything to a pulp industry. Special problems are associated with the establishment of coniferous species in soils and climates alien to them which may limit indefinitely the exploitation of such species in many of the new countries.

5. Hardwoods

(a) It remains to consider the hardwoods, which constitute the greater part of the forest cover of the majority of tropical countries. The term "hardwood" is used here as it normally is in the paper industry, to include all broad-leaved (i.e. non-coniferous) trees.

(b) The traditional paper making materials, as indicated above, are softwoods derived from temperate or sub-arctic coniferous forests. Even in the established pulp-producing countries, however, considerable attention is now being given to the use of hardwoods for pulping, especially thinnings from saw timber plantations, and new pulping techniques, suitable for hardwoods, have been developed.

(c) Natural Forest Hardwoods

The exploitation of existing tropical forests for pulpwood presents major problems.

(i) Extraction costs from dense high forest are often high, on account of difficulties of communication and access. These high costs may well be justified in the case of valuable saw and veneer timbers, but are less easily borne by the cheaper pulpwood.

(ii) Tropical forests are usually heterogenous in composition. Selection of a single species for pulping would be difficult, while mixed hardwoods generally yield pulps of only indifferent quality, which tend to be expensive, in terms of chemical consumption, to produce.

(iii) Regeneration of tropical forest after cutting is a complex process, and often gives rise to secondary forest of a very difficult composition to that originally existing.

(iv) Tropical forest species often command a higher price as timber than they would as pulpwood: this is especially true of many of the valuable West African veneer timbers.

(d) Plantation Hardwoods

It is not always realized how rapidly plantations of some tropical hardwood species can be established, under favourable conditions.

(i) As an example, figures may be quoted for the Asian species, Gmelina arborea Roxb., which is already well established in Nigeria and other West African countries, being used for firewood plantations and low-grade timber. Growth rates naturally vary with soil and rainfall, but a harvest of over 3000 cubic feet per acre, of a suitable size for pulping, can reasonably be expected after as little as 8 years growth in the Rain Forest zone, 10 years or more being required for the same yield under savannah conditions, given reasonable soil conditions. This species can yield a pulp suitable for the manufacture of writing and wrapping papers.

(ii) Many other quick-growing hardwoods are known, which are already being used on a plantation scale in West Africa for the supply of firewood, and similar purposes. These hardwoods in many cases have a great advantage in that, once established, they can be coppiced regularly, and the timber thus harvested at frequent intervals - of only a few years, under optimum conditions - without the expense of replanting. Of all hardwoods, the eucalypts are probably the best known for their quick-growing characteristics, but species of Cassia, Tectona, Terminalia and Triplochiton are also well known in West Africa.

(e) Afforestation thinnings

Apart from the possibility of establishing plantations of quick-growing hardwoods specifically for the production of pulpwood, the thinnings from plantations of hardwood saw timber species must also be considered. As silviculture develops, it is likely that increasing areas in many of the emergent countries will be devoted to artificially planted forests of the more desirable timber species. In some cases, large quantities of thinnings from these forests may become available for pulping, as is already the case in some of the more industrialized countries.

6. The Use of Marginal Land

(a) Extensive areas in many of the emergent countries, especially in Africa, are of a semi-arid nature, frequently more as a result of a long dry season than of low total rainfall. These areas are unsuitable for normal forestry operations aimed at the production of high-quality saw timber. Unsatisfactory agricultural techniques have often resulted in the widespread destruction of existing forest cover, and soil erosion is becoming a major problem.

(b) Some of the poorer quality hardwood species available, however, can be grown under these adverse conditions: if the timber so produced can be exploited industrially for the manufacture of paper pulp, a stimulus will be provided for the afforestation of such areas. Afforestation of savannah country - which, at least in West Africa, is often "derived savannah", i.e. land which was once forest, and has been degraded to grassland or scrub as a result of human influence - will, in its turn, produce many benefits in the form of erosion control. and possibly even amelioration of climate, together with local social advantages.

(c) It is considered, therefore, that a paper industry, if supplied by locally manufactured pulp from suitably selected plantation timber species, can contribute greatly to the exploitation of the marginally useful savannah lands that form such a large part of the available land space in many tropical countries.

7. The Need for Research

(a) In view of the relative unfamiliarity, to the paper maker, of most tropical hardwoods, extensive research will be necessary in order to ensure effective and economic utilization.

(b) Pulping and paper making trials have already been made on a considerable number of tropical hardwoods.

(i) Most of this work, however, was carried out in laboratories situated thousands of miles from the country of origin of the material. Although these investigations - made, notably, in the United Kingdom, France and Belgium, - provide a useful basis for further work, their value is, in many cases, subject to considerable limitations.

(ii) Research in this field can best be conducted in close liaison with the various interested parties, especially the Forestry authorities of the country concerned. Priority can then be given to the investigation of those species which are already known to the forester, and which are likely to be capable of being grown successfully under the locally prevailing conditions. Satisfactorily representative samples can easily be obtained for pulping trials, and the variation in properties with age, climate, soil, etc. can effectively be studied.

Material used for experimental work can be freshly cut, or, if desired, stored under known conditions for definite periods. These desiderata have rarely been achieved in the investigations carried out in overseas laboratories, where the research workers frequently have little knowledge of the relevant local conditions, and are, in any case, remote from their supply of experimental material.

(c) As an example of the successful application of research in this field may be instanced the work carried out in Australia on the pulping of various species of Eucalyptus. The Australian paper industry now depends to a very large extent on locally manufactured Eucalyptus pulp, although much opposition to the feasibility of its use was encountered in earlier years, and a heavy expenditure on research had to be made.

(d) Among the newly emergent countries, in West Africa, Nigeria is pioneering the investigation of tropical hardwoods, with especial reference to species suitable for plantation development. The Federal Institute of Industrial Research, at Oshodi, near Lagos, is now equipped to carry out pulping and paper making trials, and the testing of paper under recognized standard conditions. Few results are available to date, as this section of the Institute was fitted out only in 1961, and special arrangements have had to be made for the training of staff, but it is hoped that, in the near future, valuable research on the pulping and paper-making uses of tropical timbers may be carried out, leading to the establishment of a successful indigenous pulp industry, and the afforestation of substantial areas of marginal land.

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